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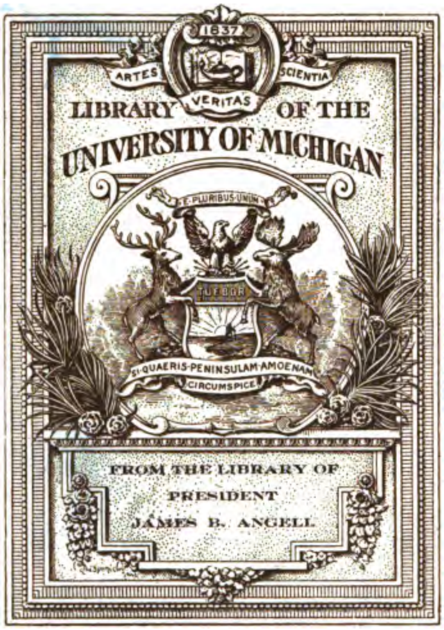
N. Y. State Agricultural Society.

ADDRESS

ON

AGRICULTURAL EDUCATION.

By ANDREW D. WHITE,
PRESIDENT OF CORNELL UNIVERSITY.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ADDRESS

ON

AGRICULTURAL EDUCATION,

DELIVERED BEFORE THE

N. Y. State Agricultural Society,

AT ALBANY, FEBRUARY 10, 1869,

BY ANDREW D. WHITE,
ickson

PRESIDENT OF CORNELL UNIVERSITY.

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ADDRESS.

Apart from one or two great political and moral questions of our day—questions of life or death, and which, apparently, must be settled soon,—no national problem is eliciting more earnest thought than the relation between education and the great fundamental industries.

This thought you see taking firm shape in various countries; shapes often vague and unreasonable, but sometimes crystallizing solidly into institutions.

The whole brood of littérateurs may declare against this thought, may ridicule it, may ignore it; the whole brood of scholars may proclaim the beauty of the honored old courses of study, may indeed prove quite satisfactorily that they are the *only* courses; and yet men in all parts of this land and other lands keep on thinking upon this question of a new education, keep on planning for it, keep on thinking that it *ought* to be, keep on believing that it *will* be.

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In England, tied more firmly than any nation to mediæval systems of education, you see Lawes and Gilbert, one giving his fortune, the other giving his life-work, in the application of science to agriculture, at the laboratory and farm of Rothamsted. You see Voelcker and many compeers, in their laboratories and lecture-rooms, bringing scientific methods to bear directly on sources of fertility. You see an eager body, of whom Mechi is a type, bringing the results of these theorists to bear upon economic practice. You see a peer of the realm,—one of the lordliest names in English history,—seconded by a goodly faculty,—carrying on the Agricultural College at Cirencester, endeavoring to send forth every year a few apostles of scientific agriculture.

So, too, in France, the nation most given to revolution, but also most given to routine, you see the idea of scientific education, pure and applied, taking such noble shapes as the Polytechnic, the Schools of Arts and Trades, of Manufactures, the Imperial Colleges of Agriculture at Grignon, La Saulsaie, and elsewhere.

In Germany, where the older scholarship has had its fullest bloom and fruitage, you see a host of magnificent establishments of this new sort, typified by the Polytechnic Schools at Carlsruhe and Stuttgart, the School of Manufactures at Berlin, the Agricultural College at Hohenheim, and the Agricultural Department of the University of Bonn.

And in our own country, the legislation of Nation and of States, the utterances of the press, various plans, various attempts, show the same longing and belief.

All this is new, much of it is crude. There have been stumblings, and blunderings, and failures, and there will be more; but the idea lives. Evidently, it is not to be scolded out of existence by solid review articles, or pooh-poohed out of existence by pleasant magazine articles. Evidently the idea is rooted in our planet, and will hardly be pulled up by narrow literary men, who hold the time-honored studies the most "eminently respectable;" or by narrow practical men, who disbelieve in "book learning;" or by narrow religious men, who fear that geology may harm Genesis.

So much for the strength and prevalence of this thought. The question then arises:—has this idea of a new education foundations?

Numbers of excellent men will tell you that it has none; that the old methods will never be superseded; that the studies which best suited the world in the days of ERASMUS best suit it now; that there is no other mental discipline comparable to that supplied by the time-honored courses of study.

Elsewhere I have attempted to answer this: the full answer seems not difficult, but I shall not now repeat it. The simple fact that these ideas have struck so deep and spread so far gives sufficient basis for what I have to say to-night. The hold which they have on so many earnest and capable men in all lands certainly raises a sufficient presumption that there is something in them.

I pass then to the first practical question—*what shall this new education be?* In this system of education, which we hope to see established—this system which coördinates the development of the human mind and the development of national industries,—what shall be our aims and methods?

First of these I name the education of the power of observation.

Moving before us all is this great God-given panorama of things and thoughts,—of forces and currents,—of growth and decay. It spreads in special beauty and wealth before the Agriculturist. Unfortunately, while all *see* it, few *observe* it. Men generally see clearly only what others have pointed out to them;—they have not the habit of detecting for themselves new good so as to use it, or new evil so as to shun it.

Millions of men had seen the steam rising from a kettle. JAMES WATT saw that and more, he observed in it *power*, and therefrom he drew the steam engine.

From the earliest ages, men had seen trees. JOHN SMEATON *observed* them, and built Eddystone light-house.

Sailors on every sea had looked at the teredo,—Brunel observed it, and found therein a model of the shield and enginery for the submarine tunnel.

In all lands, men had scratched the earth with rude implements for centuries,—they had seen the furrows their fathers had made,—they had seen the instruments with which their fathers made them. In these latter days, strolling out on the Roman Campagna, I examined the first plow in my way, and found it exactly the plow described by Virgil.

But modern men, in countries more active, observed the instrument and the problem, and forth came the series of modern plows; and the wealth of the world was increased more than by new Golcondas.

Those who see are millions; those who observe are but scores. Every addition to this corps of observers is an addition to the wealth and force of the country.

Now nothing is more certain than that these powers of observation can be cultivated in men who have them partially, and aroused in men who have them not at all.

Interest a young farmer in natural and physical science—especially as applied to things which bear on his tastes or aims or general pursuits, and you have given to his powers of observation a stimulus;—educate him to a moderate degree, and you give him method;—educate him thoroughly, and you give him power.

It is wonderful to note how the powers of observation may be thus trained. At the Rothamsted laboratory, Dr. GILBERT pointed out to me peasant boys with bundles of grasses before them. They were great bundles, representing the results on different plots enriched in different ways. These boys, with a quickness almost preternatural, sorted out all the different species, placing each by itself, that the definite result of each mode of treatment on the growth of each kind of grass might be accurately known. Merely to see once this exhibition — this thoroughness of observation by the master, this quickness of observation by the scholar—was in itself a lesson never to be forgotten.

That power of observation is the power which in agriculture has steadily perfected machines, improved herds, and flocks, and fruits, dried marshes, restored the lands of exhausted States.

It is more than that;—it disciplines men for observations of all sorts, not only for things of matter, but things of mind.

The next thing in this education of which we speak, is the education of the power of practical reasoning. This is closely allied to the power of observing, exceedingly important as to its general effect;—as to its complete effect, vital. For it constantly happens that there must be not merely observation of a single train of facts, but also a proper connection between several trains of facts.

Observations had been made on small-pox observations had been made also in animal pathology. **Jenner** combined the two, and gave the world Vaccination. Men had noted the speed of the galvanic current;—they had also observed the power of the current to produce temporary magnets. **Morse** combined and reasoned, and produced the first registering electro-magnetic telegraph.

The general phenomena of vegetables had been observed, the chemical constitution of substances had been observed. **Liebig** combined reasonings on both, and developed the science of Agricultural Chemistry.

In that wonderful History of Civilization, which, incomplete as it is as a whole,—wrong as it is in parts,—is one of the greatest of human works, **Buckle** declares that in the scientific world the results of observation are piling up to great height;—but that what is wanted is the reasoning to combine these observations, and to deduce principles from them. So in the practical world observations are made in vast numbers. Our reports are filled with them; but we want men trained to combine them, to reason upon them, to deduce from them the meanings which are fraught with good to industry and to man.

Can men be better educated to this also? We believe that they can. For ages men have been taught to reason acutely on theological and metaphysical problems; for many years men have been taught to reason on questions of natural science. All analogy shows that the old methods applied to the new problems would do much, and, doubtless, out of them would come new methods which would do more. Take the young student, bring him thoroughly into the trains of reasoning followed by LIEBIG, or FARRADAY, or JOHNSON, or GILBERT, and you prepare him to bring his own reason to bear on observations in the same way.

The third object of such an industrial education which I name, is to bring these powers of observation and reasoning to bear on practice.

Here comes in the necessity for large acquisitions of scientific and general knowledge. For, first of all conditions to this, you must instruct the student what the general problems are; what steps have been taken for their solution; what laws, natural and physical, God has given to aid in their solution; what appliances and combinations man has constructed for it; that is, you are to instruct the young man thoroughly in the sciences and arts on which the great industries are based.

Of all the great pressing *material* needs of this land to-day, this is the greatest. We have the most ingenious people, the most earnest people, the most wide-awake people, the world has ever seen. We have not the system of instruction to make this ingenuity and earnestness tell to the best advantage—to keep them from giving years to investigations already made, or working at problems already solved. Great as are the results of American ingenuity and skill, I believe that they would be at once doubled and quadrupled by a proper system of advanced instruction bearing upon Agriculture and the Mechanic Arts. Who can estimate the value in money to this nation of the Mower and Reaper, the Telegraph, the Sewing Machine, the Steam Engine? But there are, doubtless, other inventions, in the ages ahead of us, as good as these. Doubtless, if we go on as we have been going on, we shall stumble on one after another of them during the coming centuries. But, with institutions of practical learning, such as we ought to have, such as France, and England, and Germany already have, I firmly believe that these inventions would come rapidly. Place such an institution as the French Conservatory of Arts and Trades in the midst of this intensely ingenious and practical people, and it *must* give an immense stimulus and a noble direction to all this ingenuity and activity.

I maintain that this advanced, thorough education, bearing directly upon the great industries, Agriculture, the Mechanic Arts, Engineering, Mining, &c., is what the country now materially most needs.

And here I combat an error—an error which some excellent men have fallen into—an error which has terribly injured Industrial Education already, and which, if persisted in, will ruin it.

This error is, that your endowed institutions for education, applied to industry, are intended to give *primary* instruction in the rudiments of Agriculture and the Mechanic Arts; that is, that in Agriculture they are to take young men who never touched a spade; who do not know wheat from barley; who are too indolent or too proud to go upon a farm, and teach them the A, B, C, of farming—the usual method of spading, hoeing and plowing, just as they might learn it in every field of this broad land. Or, that in Mechanic Arts they should take young men too indolent or too proud to go into the workshop, and set them at playing with tools, in the hope of teaching them to wield a hammer or shove a plane.

In short, the error is that a royal road shall be given young men, by allowing them to play Mechanic or play Farmer, while their parents are too proud to let them do the real thing.

Nothing can be more absurd,—nothing more repugnant to the spirit which has prompted National and State endowments,—nothing more fatal to the true practical purpose of these institutions.

The true schools for the *primary*, usual instruction in the Mechanic Arts, and for learning any special trade, are the workshops of the country. They are the most accessible,—the most simple. Does a young man really wish to learn to handle saw, or chisel, or plane? these are the practical schools, these the practical teachers. They are all about him—just where they are wanted—in every city, in every hamlet. For that primary work—the learning the usual uses of the usual tools—no other schools can compare with them. Multiply your present endowments by thousands, and you cannot supersede the work of these primary industrial schools almost within a stone's throw of the hearth of every man. If you attempt to do it, you will fritter away your educational resources, and add, probably, one poor shop to the millions of good ones.

The same is true of Agriculture. For instruction in the simple fundamental processes of farming, the schools are the farms. They are spread all over our country. They are ready to receive all young men who seriously wish primary training in Agriculture. Even though the farm be poor,—even though the processes be rude,—that is the necessary preliminary school. It is accessible; it enables the young man to pay his way; it enables him to get time, if he be thoroughly in earnest, to profit by the common school, the book and the newspaper. Rudimentary instruction as to implements and processes, can be got nowhere else so well. None other can supply the demand.

Multiply your endowments for Agricultural education by millions, and you cannot meet this demand. You cannot supersede these myriad farm-schools in every valley and on every hillside. Attempt to do it, and you fritter away your endowment, and simply add one poor farm to the myriads of good ones.

The same is true in regard to the Sciences and useful Arts in general. The places for *preliminary* instruction are the public schools. They, too, are scattered through our State—almost literally within the sight of every household. Every year the State gives millions to them. Thank God for it. Pardon me for saying that, if there is one thing in my life on which I shall never cease to reflect with gratitude, it is that beneath this roof* I had the honor to introduce and report the bills which made those schools free, and which established the new normal schools to make them effective.

But, while thus honoring primary education, I insist that it is folly to waste the special endowments of institutions for advanced instruction in Agriculture and Mechanic Arts in attempting to duplicate or supersede these primary schools.

What then should the Colleges for the promotion of Agriculture and the Mechanic Arts attempt to do?

I answer: They should take young men where the farm, the workshop, the common school, leave them,—young men who have already received a good sound knowledge and experience in the simple, usual processes of Agriculture, and on that they should build, making them master farmers; thoroughly based in science bearing on Agriculture; thorougly trained in the arts bearing on Agriculture; trained by studies of nature to use their powers of observation; trained by studies of science to use their powers of practical reason; trained both by study of sciences and arts to bring these powers of observation and reasoning to bear on important practical questions. Having learned much of the usual processes in farm work, they should be made to investigate new processes to find the facts or fallacies in them. They should be made to study not merely the plow and plowing as they could easily study them without stirring from their fathers' farms, but the very best theory and practice of plows and plowing, of enrichment of soils, of drainage of lands, of rotation of crops, of construction of buildings, of breeding of animals, and the like.

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* The Address was delivered in the State Capitol.

With these should also be taught the principles of accounts, so that the student would know, not merely the farming which a millionaire might play at to deplete his fortune, but the farming which a thrifty settler might work at to increase his fortune.

This has been done. At the English Agricultural College of Cirencester, I saw accounts kept by students with every field, every garden-plot, every experiment; that the education might not only tell on general science and practice, but on economical science and practice.

And here let me say that I would adopt another rule of that College at Cirencester. I would let no man graduate until, in addition to his thorough examination in pure and applied science, he had gone out on the farm with two experienced agriculturists and had passed a plain, thorough, common-sense examination in practical Agriculture, answering their questions, how this field was treated and why; what labor was employed on that field, and with what economic result; what he would recommend for the other field and why? and so on to the satisfaction of the special committee.

You may by these methods send forth every year a brood of apostles of improved Agriculture—apostles who shall go forth to preach the Gospel of an Agriculture, which shall be better scientifically, practically, and economically—apostles who shall develop Agricultural virtues and fight Agricultural vices; whose farms shall be centers of new and good ideas, fortresses against quackery.

Take two examples of this. In 1818, De Dombasle established the Agricultural College of Roville. For several years, that establishment was a blessing to France. Records of its practical and experimental Agriculture were published, and with the best effects; but at last Dombasle had sunk health and fortune and the College stopped. It was spoken of as a failure. Was it a failure? Two young men quietly went out from it and wrote an answer on the soil of France—wrote it in letters so deep and wide that it will never be effaced. The first of these young men went upon the wretched barren heaths of Brittany, took over 1,200 acres, brought to bear upon it the science and practice he had learned at Roville, and produced a noble, fertile farm. That farm is now the seat of an Agricultural College, and a center from which has radiated scientific and practical knowledge for the reclamation of all that part of France.

Another pupil, M. Nevière, went forth. He went to the southeast of France. There he found, near the confluence of the Rhone and

Saone, a district of sixty-seven square leagues—a marsh, supposed to be irreclaimable, with a scanty population dying of fever. He took a farm of 1,600 acres, applied methods learned at Roville, and reclaimed it in two years. The reclamation of the remainder followed, the fever rate sank from twenty per cent. to one-half per cent. of the farm hands; the district is now the seat of a thrifty, healthy population, and in the midst of it stands the Agricultural College of La Saulsaie, a center of scientific and practical knowledge for all that part of France.

At the Imperial College of Grignon, they showed me a map of France, all dotted over. Each of those dots represented a graduate. There they were, in every corner of the country, each man thoroughly trained in the best science and practice of Agriculture, and justly indeed is that institution proud of their character and influence.

The purpose of the department of the Mechanic Arts should be similar. It should aim to take the young man, when the workshop and the common school leave him, and make a thoroughly trained, scientific and practical master mechanic of him.

It is hard to make this idea understood at first. I have had ample opportunity to learn this difficulty during the last three months, while engaged in organizing the department of Agriculture and the Mechanic Arts at Ithaca. The wrong idea continually met us in shapes sometimes pathetic, sometimes ludicrous.

One father and mother brought their young gentleman, who could do nothing anywhere else. He had whittled out a toy very simple to the eyes of the world generally, very wonderful to the eyes of his fond parents. On the strength of this toy, it was evidently expected by them that he could get an education in books by droning over them, learn the use of tools by playing with them, support himself while thus amusing himself, and mend his morals and manners while engaged in that branch of practical Agriculture known as "Sowing Wild Oats."

Another young gentleman, city bred, sickly, weakly, who had not the experience of any skilled labor, who had not the strength for any unskilled labor, wished to support himself by work while pursuing his studies; but when he discovered that work makes a man tired, wears his fingers and soils his clothes, he withdrew, making the air vocal with his complaints.

Another, with no available trade, no aptitude for labor, offered to favor the institution with his presence if he could learn a trade, carry on his studies, and save enough to board, lodge and clothe himself, beside sending twenty-five dollars a month home to his mother.

These are actual cases, and types of many others. It hardly need be said that these persons were all sadly disappointed, and that some of them were fierce in their denunciation of an institution which does not wish to begin its agricultural and scientific career by endeavoring thus to extract sunbeams from cucumbers.

I repeat it, our duty is not to do such work as this. We are not to establish a reform school, nor an intellectual alms-house. We should take sound, manly, capable young men, where the farms, the shops, and the preliminary schools leave them, and give them back to the country strong to develop and increase the resources of neighborhoods, states and nations. I repeat that this is to-day the most pressing material need of this land.

Take first the Mechanic Arts. It is easy in this department to make good my assertion that the blunderings and stumblings of unscientific master-mechanics and engineers have cost more than enough to endow splendid industrial colleges in every State every year. Every State, every city, every canal, every railroad, has a wretched story to tell of imperfect estimates, bad plans and sunken capital. Out of the myriads of actual cases, take the first which occur to me:

In one city the simple problem was to carry a principal street over a stream at an acute angle: it required a "skew arch" bridge. You see them beautifully made all over Europe; but here was not an engineer who could construct one scientifically. Expedients and shams were resorted to, and as the sequel to each the bridge fell, and great was the fall of it, judging from the tax levy.

Another town has a skating rink. There are certain scientific applications of mechanical principles which will make a much larger roof absolutely sure against any possible pressure. They showed me at Moscow a roof five times as large, upheld without a column; but half-skilled, uninstructed mechanical engineering is resorted to in this case, and the roof falls; and a bevy of children, tortured, maimed or killed, are dragged out from its ruins.

Another city has a great school; proper instruction in strength of materials and crushing forces would have made all secure; but avarice and ignorance combine, the builder rests his principal beam on an insufficient corbel, and a whole hall full of simple-hearted mothers and merry children are precipitated, in a moment, into the abyss below, and the city plunged into mourning.

A railway company wishes to overcome a formidable steep. One expedient is tried which costs much and comes to little; then a second, which costs more, and is little better; and now they are about trying a third.

A canal has to cross a river. The engineer, a man evidently of half-instruction, makes no sufficient calculation for the water to be discharged beneath the arches; the river and the lake which feeds it are "set back," and whole counties are afflicted with malaria, of which the real cost can only be expressed in millions.

A patent-monger comes into a State, and common sense, half-instructed, mechanical engineering discovers no flaw in his pretensions; he sells his right, scoops up a fortune from county after county; manufactories are erected to make his machines, and it is found that some little scientific calculation, or some little scientific principle, was ignored, and all is wreck. Money enough has been lost in that way alone in this State to endow the most splendid schools of manufactures and engineering in the world.

In Agriculture the same thing goes on, less apparently, not less really. Soils of whole districts are enfeebled and exhausted by ill-advised culture. The application of certain simple scientific principles would have kept the soil up to its highest productiveness.

Waste of the richest materials goes on. Materials are rejected as refuse which science would coin into gold. Good men see this. They make experiments; they report them. Unfortunately, they have hardly ever the scientific training to make their experiments thorough, or their reports exact. So their experiments mislead, and throw doubt on *all* attempts to better Agriculture.

See for a moment what other lands, with not a tithe of American ingenuity and activity, do for this work. From the multitude of examples I will select two, one in mechanic arts, the other in agriculture; one in France, the other in Germany.

First of these is the Conservatory of Mechanic Arts and Trades at Paris. You pass first through long halls filled with machinery and apparatus. Every subject is represented by everything which can illustrate its development, character or application. Electricity is represented by every form of machine, and battery, and pile, for producing it; by every form of apparatus for studying its principles or exhibiting its effects; by every form of telegraph; by every form of electro-motor.

Steam is illustrated not merely by apparatus, but by every modification of the steam engine from the days of Papin or Savary. There are scores of working models beautifully constructed, representing the progress of the steam engine from its earliest days until now; stationary engines of every form, and for every work; long rows of locomotive engines, exquisitely made, to display every useful modification; case after case of marine engines, of every construction—French, American, English or German—and so perfect that they can at any moment be set at actual work before the student. There, too, is every form of useful machine for raising water, every form of machine for marking time, from the earliest clepsydra to the latest chronometer;

printing presses of all sorts; locks and locksmiths' work of all sorts. Here are the weights and measures of all nations; there the railway constructions of all nations—tracks, switches, trucks, wheels, brakes, all classified and arranged. Here are rooms filled with mills for every purpose; furnaces and machines for the extracting and refining of gold and other metals, for the extracting and refining of sugar and other products. Here is an immense hall, where machines of all sorts are in operation; here a splendid library, filled with the industrial works of all nations; here lecture-rooms, where the best professors instruct young men to uphold and extend the national glory as master-mechanics or engineers, using freely all these vast collections in illustration.

You say, perhaps, that this is the creation of a despot. Not at all. It was the creation of the people—a child of that great and glorious first French Revolution, which, despite English Tory historians and their American toady imitators, was one of the noblest and most fruitful efforts the world has yet seen. That school, and others like it, were the creation of the French people, and I believe the time is coming when like things will be done by the American people.

Take, now, an example among agricultural colleges. Take the college at Hohenheim, near Stuttgart. As you stand before those noble old buildings, you look forth first over the broad acres of a great model farm, a farm conducted in the best manner possible as regards laying out, processes, implements and economy. Directly in front of you a wonderful union of beauty and of use is the botanic garden, where fundamental principles of vegetation are clenched into students' minds so that they are sure to be retained. Yonder is the experimental farm, where science is at work observing, noting, combining to push further and further the domain of useful knowledge.

Enter the buildings. Here you have laboratories for preliminary training and for experiment; lecture-rooms thoroughly appointed; collections of models,—among them one series of one hundred and fifty models of plows; collections of agricultural implements, collections of agricultural products, all arranged for effective instruction. Here is the department of veterinary surgery, with long ranges of models, instruments and specimens—with collections, for example, of horseshoes of every form, for every foot disease and every use.

You enter buildings where are ranges of improved breeds of living animals; workshops, where agricultural implements are constructed, all uniting science with practical value.

You enter the dwellings of the professors. Pictures are on the walls, books on the tables: there is that atmosphere of culture and refinement which does good to any student, even though his life-work is to be in the backwoods.

That institution has added to the value of every acre in the kingdom where it stands. Although those who till the soil are comparatively oppressed, uninstructed, unenergetic, it has bettered their condition. What, think you, will such institutions do in our American States, with their reading, thinking, energetic yeomanry?

And let me say here that there is one important element in our favor which they have not—the homogeneous character of our people.

For at this college, after making acquaintances among professors and students, I saw a large body of young men more plainly dressed, entering a lecture-room. Asking who they were, I was told that these were *peasant* students, not admitted to the same instruction with the others, but trained apart, to be small farmers and gardeners.

I then realized fully the great difficulty in their case, which we have not. There, save in rare cases, the son of the peasant farmer cannot be admitted on an equal footing with the son of nobleman or gentleman. If he were generally so admitted, gentlemen and noblemen would not send their sons. Every great agricultural college in Europe must either be cut into two parts, with peasant sons in one and the gentry in the other, as at Hohenheim, or they must exclude peasants' sons altogether, as at Cirencester.

Here, thank Heaven, we have no peasantry, and no such difficulty can embarrass colleges or offend the moral sense. Here, at least, we can admit all persons of all races and conditions on an equal footing. Here, happily, we are freed from those distinctions of caste and creed. The prospect in America is good, indeed. If we plan wisely, if we build carefully, we shall rival the Old World in these institutions; but to this end we must observe certain plain rules.

First: As already observed, we must not fritter away our resources for advanced scientific, industrial and general education on preliminary education, which is given better by farms, shops, public schools and academies.

Secondly: There must be concentration of resources for advanced education. Such institutions as those we need demand a great outlay. There must be the best professors, buildings, libraries, cabinets, collections of models, apparatus, machines; there must be farms and shops, all of the best. These cost much money. To secure these we must keep funds for this purpose together. We must not fritter away the resources of a single State for this purpose on *several* institutions. It is not enough to have a professor of Agricultural Chemistry, or of Mechanic Arts, here and there. You want them brought together, with ample educational material of every sort.

In early days, when men traveled by stage-coaches, it was important that colleges be scattered over the State;—now, the case is different. Now that railroads and telegraphs have so nearly annihilated space and time, we can afford to concentrate our means.

Happily, in regard to the institutions recently created, every State save one or two has adopted this policy of concentrating resources for the highest scientific and industrial education rather than scattering them. It is now recognized as an axiom: Scatter your resources for primary education, concentrate your resources for advanced education.

Thirdly: There must be no policy which implies a confession of the inferiority of scientific or industrial education. Here some wretched mistakes have been made. A very common error has been to separate Agricultural Colleges from others—to put them into remote corners by themselves. They have thus too often come to be regarded as the inferior college of an inferior caste. The State of Pennsylvania separated her Agricultural department from all others, and then relegated it to an unattractive region—remote from any settlement, remote from any line of travel, demanding not only hard and difficult railway travel, but at all times of the year teaming over ten miles of wretched roads—and the people of that State wonder that their college is not more successful.

The State of Michigan did much the same thing. It indeed gave its Agricultural College an excellent faculty; and they have achieved much success, considering their means, but infinitely better would it have been to combine that Agricultural College with their noble University, making it a great department—making the professions studied there the equal of any profession—the farmer's son the equal of any man's son, giving him the same access to those noble laboratories and cabinets and libraries. It would have been far more economical, far more conducive to the highest interests and the truest estimation of Agriculture.

This is the policy, happily, which now begins to prevail. Prussia and Scotland, so thoughtful in all that pertains to scientific and practical education, have adopted this principle. It is imbedded in the act of Congress of 1862, which lays stress not only on education in Agriculture and Mechanic Arts, but couples with them scientific and even classical instruction. And the State of New York has adhered to this same policy, by uniting the colleges of Agriculture and the Mechanic Arts on an equal footing with other colleges for other branches in one university, where each and all can be made better and broader by bringing general culture to bear on special culture. There is, indeed, a superstition in some quarters that studies for general discipline and culture and studies for special discipline and culture should not be brought together in the same institution; that there is an incompatibility of temper and pursuit between students whose aim is mental discipline, and students whose aim is a special profession.

I meet this *theory*—for it is simply that, on the ground of theory. Two-thirds of American students, while supposed to be studying to "discipline their minds" (that term has become very nauseous) are really studying in view of professions and duties beyond.

But why trouble ourselves with theories, when we can better meet the notion with plain fact? The plain fact is, that the two sorts of education *have* succeeded well together, and *are* succeeding well together. Students for general culture and students for special professions herd together in the greatest universities of Germany; and there has been no such trouble as these theorists say there ought to be. Students have for years met in the halls of the University of Berlin: one goes to hear BÖCKH and CURTIUS for Greek and Latin history and literature, with a view to general culture; another goes to hear SAVIGNY or GNEIST on Law, in view of a special profession; another goes to hear HENGSTENBERG or NITSCH on theology, in view of a special profession; another into the laboratory of HOFFMAN, in view of a special profession; and there has been no explosion yet.

So, too, in the class rooms of our own University of Michigan. You may every day see students in general courses sitting in lecture-rooms beside students who are to be civil engineers; and then, again, sitting beside those who are to be lawyers: and so far from being injured, all are thereby made better and broader.

I firmly believe that if the herds of young men who are droning over the metaphysics of the Latin subjunctive or the abstrusities of the Greek accents, and thus holding back those who are pursuing classical studies earnestly, could be brought directly into contact with the active, energetic study and practice seen in chemical laboratories and geological cabinets, their force and usefulness would be greatly improved thereby.

Again: you must tie these schools to no single sect. Sectarian institutions have done good work—no one can doubt it— but for your scientific and industrial institutions you want no sectarian control. I think all our sister States would do well to incorporate that provision of the State charter to the Cornell University: "And no person shall be accepted or rejected as officer, professor, or student, on account of any religious or political views which he may or may not hold."

If any person wishes to found or endow a sectarian institution, he is at liberty to do so, and we all wish him God-speed; but we have no right thus to fetter special State or National endowments. Professors must be selected not because they are or are not Presbyterian, Roman Catholic, Unitarian, Baptist, Episcopalian, or Methodist, but because they are the *best fitted to instruct.* On this principle alone, can you ever have worthy institutions for scientific and industrial education.

Nor should you be too much afraid regarding truth. All over the land, you shall find well-meaning gentlemen in terror lest, somehow, scientific studies upset God's truth. They seem to think eternal truth the weakest thing going—a thing to be perpetually coddled and bolstered. Their predecessors trembled and bit, and burned, for fear of the idea that the earth revolves about the sun; then they were alarmed at Geology; then at Zoölogy and Chemistry, and now many of them seem to think that it is safe to study nothing save some language so dead that it cannot possibly do harm.

Look into History, and you discover that Truth has taken care of herself wonderfully well. Grand as glorious JOHN MILTON'S praise of her power was, it was not a whit overstated.

Curiously enough, the main supporters of truth in every age have generally been the men thought heretics; and the worst opponents of truth in every age have generally proved to be these same timid gentlemen who have feared lest truth receive some detriment. Look through the whole range of History: you do not find one of the scientific investigators who has implanted a permanent error, but you find hosts of their conscientious opponents who for ages have cut out and burnt out truth. God's truth is mightier than the poets make it. Men's interpretations of truth are constantly changing; truth itself is never endangered. A true man—a man who has any faith—cannot fear Science.

Again, whenever a "Manual Labor System" is attempted, it should be carefully adjusted to the demands of scientific and practical education.

The question arises what this manual labor should be. There are two theories. The first is that its entire aim should be to give the means to students of supporting themselves—that a profitable farm on a very large scale should enable a large number of students to support themselves by Agriculture, and that workshops on a large scale, for the manufacture of some simple fabrics of universal consumption, should enable a large number of students to support themselves by Mechanic Arts; that in both these cases the main thing should be self-supporting industry, and not educational industry.

The second theory is, that the primary object of the manual labor in both departments should be educational; that is, that the work should first of all be done with a view to perfect the student in the best processes, and to make him scientifically and practically a first-class Agriculturist or Mechanic.

My opinion is that the first of these is *desirable*, the second *essential*.

If possible, we must do both; in any case, we must do the second thing.

For the endowment was given by the United States, primarily, not to aid ten, or twenty, or fifty young men to support themselves, but to enable hundreds of young men to obtain a thorough practical and scientific education, in order to develop the industrial resources of the nation.

Take first Agriculture. Here I would combine the two aims; always, however, holding manual labor, which has an educational value, of more importance than that which has not.

I would, first of all, lay stress on first-rate farming, and first-rate farm construction. I would have a model farm and an experimental farm, and botanic gardens, and roads, and dykes, all carefully studied out and thought out; all as a part of a system of educational value, both while it is constructing, and after it is constructed. I would have students carry out scientific and economic principles in practical experiments on modes of culture likely to be practically beneficial to the State. That is the manual labor system which has a special educational value. Its object is the best farming, and to make the best farming pay.

But while this is done, there will always be work at which a considerable number of students can, in many cases partially, and in some cases entirely, support themselves while pursuing their studies. Where so large a body of students are assembled as at the Cornell University, there is established, at once, a market for the products of a very large farm, employing a number of young men.

To do this work, we have organized voluntary labor corps, paying as nearly as possible what the young men earn—no more, no less—and it is found that a large number can thus secure healthful exercise, and at least partial support. I say *voluntary* labor corps, because the number of students is so great that all cannot be employed at hard labor, and because, the world over, *forced* labor is unprofitable labor.

To sum up regarding Agriculture: It seems easy to coördinate the two aims—to carry on at the same time labor of educational value and of pecuniary value.

In mechanic arts, it is more difficult; here your market for the products of ordinary labor must be generally sought elsewhere, and it must be necessarily precarious.

For this department I would begin having in view *educational* manual labor. I would, to this end, begin with a workshop furnished with simple machines and tools for working in wood and metals, such as lathes, planers, drills, and the like, with a small steam engine as a motor. In this, under the direction of a professor who should be not only a thorough scientific man but a practical mechanic, I would have such students as have proved themselves fit for it make models, apparatus, implements, &c., in furtherance of their studies.

Say for example, that the institution wishes models to illustrate descriptive geometry or combinations of wheelwork, or different applications of steam, I would have students study the best designs, discuss them with their professors, make careful drawings, and then carry them out practically.

If, for example, the institution wishes a model of a low-pressure steam engine, I would have the student—a young man who having learned something, of the trade elsewhere, now purposes to perfect himself, and make himself a master-mechanic,—I would have him study the best machine drawings of Armengaud, or other leading designers; then make as careful drawings, and as large, for his model as for a steamship engine, study the proper relations of parts as regards size and place, calculate closely the movement of valves, estimate power and work to be done, and then, in this shop, I would afford him facilities to construct the perfect model thus designed.

In this way, students would acquire, at the same time, the theory of machines, knowledge of the most approved construction, practice in drawing, judgment in adjustment of parts, skill in manual labor, and in many cases make a model which could be sold for enough to repay their time and labor.

The institution itself would be thus able to purchase of its students, for its cabinet, models of agricultural and mechanical construction cheaper than it could import them, and at the same time aid meritorious and needy students. Do you not see, my friends, that even a half-dozen master mechanics and mechanical engineers every year thus taught would be worth more to the State than a hundred *half* educated young men?

This is the first legitimate thing to do. After that, if some simple branch of mechanical labor could be found, which would enable a large number of young men to support themselves by more unskilled work, whether at the simplest forms of cabinet or tool making, or the like, that might be tried; but it never should be allowed to jeopardize funds designed for practical and scientific *education*.

It is a matter of congratulation that thus far our own institution has done something in both these directions.

During the first term, over $3,000 were expended in work done by students on buildings, grounds, and farm.

But the question is sometimes asked: Will not your "*voluntary* labor corps" create a spirit of caste? Will not those who do manual labor be looked down upon by those who do not?

They who ask this question show at once their practical ignorance of American students. In every American college of size—no matter what its faults—there is always this virtue: that idlers are regarded as the inferiors of workers. No purer democracies exist on the face of the earth than our great schools and colleges. It is an absolute fact that the real aristocracy at such institutions is an aristocracy of talent and of work; it is only when the young men have graduated that they accustom themselves to the opposite idea.

Whom do students at Yale, or Harvard, or the University of Michigan, or Cornell University most readily elect into their literary societies? The young men of talent and work. Every professor sees this, except perhaps in some petty colleges, where city snobbery has eaten out right, manly feeling.

President THOMAS HILL, of Harvard, swept the College yard; JARED SPARKS waited on the College table; the student who passed the best general examination at the recent close of the term at Cornell University is a waiter in the University dining hall; some of those who stood highest at the recent examination for prizes in special departments you can see any fine day at work on the University grounds with pick and shovel. I have seen, at a large Eastern college, one of the wealthiest students—a poor scholar, and one of the poorest students—who partially supported himself by labor in a harness shop, a good scholar—competitors for admittance to a very select literary club; and I have seen the harness maker elected unanimously, though the club was at that moment greatly in need of money. As student in an Eastern State, and as Professor in a Western State, I have seen this manifestation of right feeling among students scores of times. There is no danger of caste from this source.

I am well aware, too, that it is denied by some that labor of the hands and of the head can be made to go together. It is said that attempts to accomplish this have failed. *Some* have failed; *all* have not. So far as it goes, the Agricultural

College of Michigan has succeeded. The experiment has never been tried, so far as I can find, fully and satisfactorily. It ought to be so tried, and will be in this State. There is probably no such inherent difficulty as certain theorists claim. The literature in this world and the sciences which have been most healthful, have, almost without exception, been born of workers and not of idlers—of men who took part in active affairs—not of men of elegant leisure.*

But in fairness—in all this matter of a new education—its advocates have the right to ask of the State some patience and forbearance. The world is greatly afflicted, and this country more than any other, with men who clamor for fruit on the day the seed is planted. We must "learn to labor and to wait." We shall stumble; we shall blunder; we shall pick ourselves up; and again, doubtless, we shall stumble and blunder—but we shall succeed.

The existing systems of education have had over three hundred years for their perfection; the new system certainly then may ask for a decade of years.

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* FREDERICK DENNISON MAURICE has shown this admirably in one of his works.

Finally, in any great establishment for scientific and industrial education, it should be remembered that there are *indirect* purposes not less important than the direct.

While you are devising plans to make the student a first-class farmer or first-class mehanic, broaden your plans sufficiently to make him a first-class *man.*

You will not thereby make him any the less perfect as farmer or mechanic.

Let me here mention, in conclusion, two of these great indirect wants which should be kept in view in any large plan for instruction in agriculture or the mechanic arts.

First of these is the want of a due representation of the agriculturists and mechanics among the men of political power and influence. It is a want which every thinking man recognizes. It is one great cause why ambitious and energetic young men are constantly deserting the farmers' profession. They constantly see "tonguey" men taking positions of influence over substantial working men.

There is but one way to combat this, and that is to combine with special education in your departments of Agriculture and Mechanic Arts good general education in history, in the fundamental principles of law, in the master-pieces of thought and expression in our own language, and the like. Thus shall you make your master-farmer and master-mechanic a power not only on farm or in work-shop, but in the world; thus and thus only shall you give agriculture and mechanic arts their due representation in the politics of the country.

A second great evil to be met is the constant depletion of the farming districts of the greater part of their best men, and the overstocking therewith of the city populations. Every thoughtful man sees this and deplores it.

This is not so in England. There, the ambition of thriving men is to get out of city into country; here, the ambition of thriving men is to get out of country into city. Why this difference?

I am convinced that the great reason is that in England all pains are taken to make the country beautiful; here it often seems as if all pains were taken to make the country hideous.

Constantly we see among us, houses rising in the country, at considerable cost—yet glaring, staring, ugly; commonplace boxes just like hundreds of other commonplace boxes; set without

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